

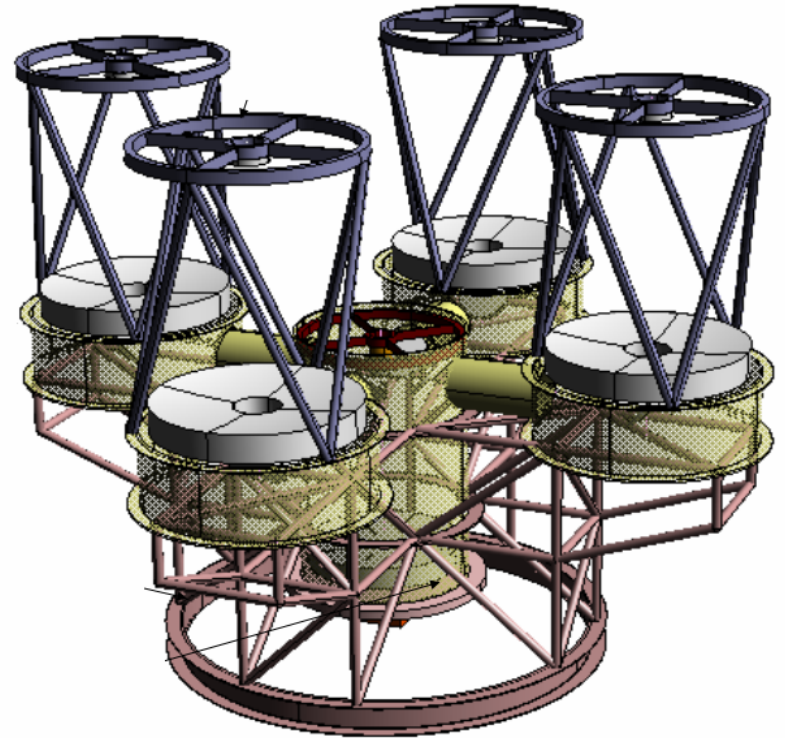
DAVINCI

Dilute Aperture Visible Nulling Coronagraphic Imager

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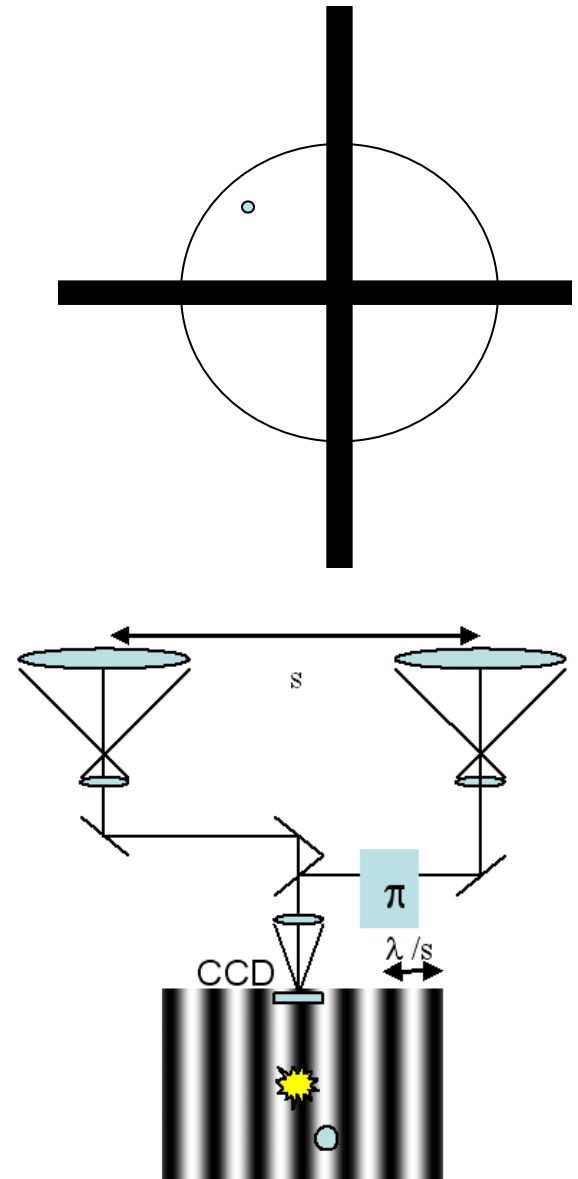
A Dilute Aperture Coronagraph

- Why a dilute Aperture, why visible?
 - Small Inner Working Angle, with moderate cost.
 - Cost of 4 1.1m telescopes
 - Inner Working Angle of a 5 m coronagraph.
- Cost of space telescopes has been studied by many experts. (Meinel, Bely etc.)
 - Cost $\sim D^{2.5}$
 - Cost of associated spacecraft follows the cost of the telescope.
 - **Potential 5~10X reduction in cost** of a coronagraph that can detect > 100 Exo-Earths (if they exist)
 - Integration time equiv to $\sim 2\text{m}$ coronagraph



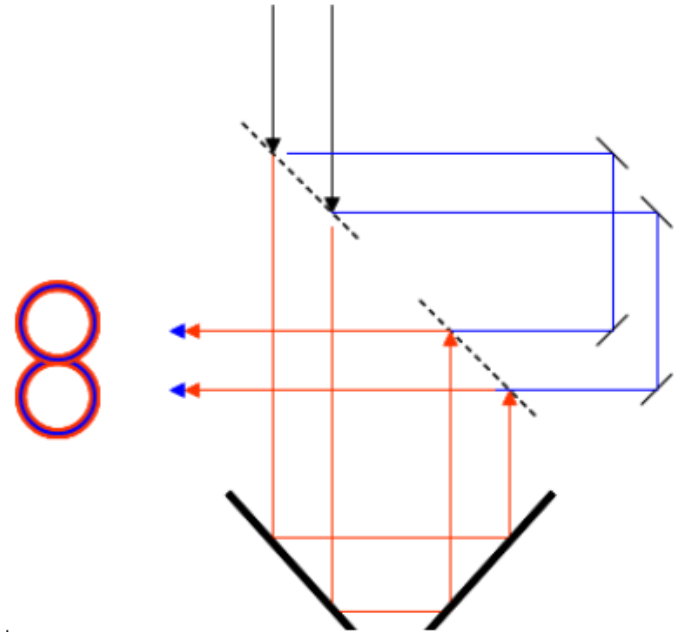
Coronagraphy with Dilute Apertures

- This is not TPF-I in the visible. The nulling coronagraphic instrument is similar to the concept we studied for TPF- C (contiguous aperture telescope). An image is formed. However the optical image has a resolution of λ/d , where d is the sub-aperture diameter.
 - The null pattern, can be very narrow, specified by the baseline of the dilute aperture. (4 apertures produce a θ^4 null for a finite diameter star)
 - If higher precision astrometry (better than $\lambda/(d \cdot \text{SNR})$) of the planet position is desired, multiple baseline orientations are needed. (for synthetic aperture imaging)



100% Lyot Efficiency

- Most coronagraphs (including the nulling coronagraph) has $< 100\%$ lyot efficiency.
 - PIAA is a notable exception
- With a dilute aperture telescope, the nuller can have 100% lyot efficiency, by not putting glass where the lyot stop would otherwise block it.
 - The nuller has sharp edges in the lyot plane.



Two way nulling combiner

Remainder of the Instrument

- Coherent fiber bundle
 - Within each fiber only control phase and amplitude
- Post coronagraph wavefront sensor (PCWFS)
 - Similar design as one used in Gemini Planet Imager, TPF-ICS study, Picture (sounding rocket), Proj 1640 Coronagraph for Palomar 5m, TMT planet imager.
- PCWFS for PSF estimation.
 - If the coronagraph is very stable, (picometer stability over a few hours) one can rotate the coronagraph to remove the speckle pattern of light inside the dark hole (from a slightly imperfect AO system)
 - The PCWFS can in theory measure the E field after the coronagraph, and estimate the speckle PSF, relaxing the stability of the wavefront by several orders of magnitude.

AMCS Selected Study

- Concept was selected as a potential Major mission in the just announced AMCS competition.